

Remarks

In the amendments above, Claims 1, 3, 4, 8-10, 12, 14-16, 19, 23, and 24 have been amended to more particularly point out and distinctly claim Applicant's invention.

Claims 9 and 20 have been objected to. The Examiner's attention is directed to the amendments above, where the amendments to Claims 9 and 20 are believed to overcome the objection.

Claims 3 and 5 have been objected to. The Examiner's attention is directed to the amendments above, where the amendments to Claims 3 and 5 are believed to overcome the objection.

Claims 1-16 and 18-29 have been rejected under 35 U.S.C §103(a) as being unpatentable over Han et al., U.S. Patent No. 6,408,050 ("Han"). The Examiner maintains that Han discloses each limitation of Claims 1-16 and 18-29.

Applicant respectively traverses this rejection.

With respect to Claim 1, Han describes an apparatus for solving the problem of superposition and reduction of "anatomic noise" in x-ray imaging devices. Therefore, Han describes static dual energy imaging to form a resulting image that is a bone-canceled image or a soft-tissue canceled image.

The claimed invention is aimed at imaging coronary and general angiography while reducing motion-prone artifacts in angiography. This procedure is a dynamic procedure, and the examination using x-ray imaging is also dynamic and is used for on-line control of cardiac/angio procedures as opposed to the static procedure of Han that is not addressed to dynamic imaging. The apparatus described cannot readily transform into an online control apparatus.

As mentioned by the Examiner, Han fails to disclose the use of a contrast agent.

With respect to Claims 1 and 20, the claimed invention describes an apparatus to be specifically used in a subject that is infused with a contrast agent. Also, in the method claimed in Claim 20, the teaching of infusing contrast agent is of much significant when working with blood vessels, and it is not obvious to a skilled person such as Han that image bone and tissues, a procedure that regularly uses the contrast of the organs themselves.

Moreover, with respect to Claim 20, Han specifically states in Col. 3, lines 17-21:

"Before an examination period ... the processor 110 sets a preselected energy threshold for the x-ray photon discriminator 106...."

As mentioned herein before, the method described in the claimed invention is a dynamic procedure in which threshold values can be selected more than once and tuned to the energy where the absorption significantly increases to acquire better and continuous results and are not preselected only prior to the examination as in Han.

With respect to Claims 2 and 3, Han teaches the specific use of CZT for his static method while he fails to teach the use of other semiconducting materials such as Amorphous Selenium (A-Se) and the dynamic method.

With respect to Claims 4-6, Han fails to teach a detector that utilizes transformation of x-ray energy into visible photons while there is no enabling of non-direct method and such detector or scintillator in Han's disclosure.

With respect to Claims 7-9, Han fails to provide any description or enablement of a readout chip as disclosed in the description and claimed in the present invention. The only teaching is of a discriminator 106 in Col. 3, lines 22-27:

"During the examination period, the X-ray photon discriminator 106 works with conjunction with the readout electronics 104 to monitor ... each pixel to count x-ray photons above the current energy threshold and to count x-ray photons below the current energy threshold."

The aspect of the claimed invention set forth in Claims 7-9 is a specific configuration of a readout chip that is not taught and not implied in Han. These electronics are crucial to proper photon counting in high rate due to the pile-up phenomenon.

With respect to Claim 10, and as mentioned herein before, since Han is aimed at tissues such as bones and soft tissues, where it is customary to use the contrast of the organs, there is no teaching or mention of infusing contrast agent. This is not relevant to Han, and infusing contrast agent before Han's examination can impair the examination rather than facilitating it.

With respect to Claims 11, 12, 21, and 22, and in continuation with the arguments given herein before, there is no teaching of contrast agent. The Office Action refers to Col. 5, lines 56-65, in which k-edge is mentioned. However, the material to which it refers is a material in the ROI that is to be identified and not an added contrast material.

With respect to Claims 13 and 27, Han refers specifically to bone tissues and soft tissues, and there is no implication to blood vessels and angiography to which the claimed invention is directed.

With respect to Claim 14, since there is no contrast agent in Han, there can be no amplification of the agent in the images.

With respect to Claims 15, 16, 28, and 29, and as mentioned herein before, there is no teaching in Han of imaging of blood vessels, and there is no referral to associated artifacts and especially not motion artifacts.

With respect to Claims 18, 19, 25, and 26, Han discloses normalization procedures. However, there is no teaching of subtraction as in the claimed invention to display a single image that is contrast amplified and free from artifacts.

With respect with Claims 23 and 24, Han fails to disclose any means or method by which the threshold is determined. Moreover, the real-time threshold determination

method as disclosed in the claimed invention is aimed at the dynamic method and apparatus for angiographic and therefore has no purpose or use in the static apparatus disclosed by Han. There is no implication whatsoever from the Han apparatus towards setting the threshold since in the static system of Han a single shot imaging is performed, which is over before setting the threshold.

Furthermore, the threshold setting is relevant to the k-edge of high Z contrast materials such as iodine. In natural body elements, when there is no contrast material like in Han, the threshold setting is not relevant.

Claim 17 has been rejected under 35 U.S.C §103(a) as being unpatentable over Han in view of Keyes et al., U.S. Patent No. 4,393,402 ("Keyes").

Applicant respectively traverses this rejection.

With respect to Claim 17 and as stated in the office Action, Han fails to disclose images are acquired, processed, and displayed multiple times as Han discloses a static dual energy procedure. Keyes discloses a processing technique for serial images to overcome motion artifacts. However, Keyes addresses the problem in a totally different approach from the claimed invention. Keyes images the subject with different energy x-rays beams and discloses in Col. 2, lines 43-47:

"the high and low energy beams always occur in close succession, such as within the same 1/30th or 1/60th of the second interval so that substantially no motion occurs between x-ray pulses"

There is no teaching in Keyes that can be implemented in Han's system so as to provide or imply on the advantageous apparatus and method that is disclosed in the present invention that covers dynamic contrast-enhanced imaging that is aimed at cardiology and angiography.

For all of the above reasons, Applicant submits that the claims are in proper form and now define patentably over the prior art. Therefore, the rejection under § 103(a) should be withdrawn.

Applicant appreciates the indication of allowable subject matter.

In view of the above amendments and remarks it is respectfully submitted that the amended and original claims are in condition for allowance. A prompt notice of allowance is respectively and earnestly solicited.

Should the claims herein be allowable but for minor matters that could be the subject of a supplemental submission or an Examiner's Amendment, Applicant would appreciate the Examiner's contacting Applicant's undersigned attorney.

Reconsideration and allowance of all the claims herein are respectfully requested.

Respectfully submitted,

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